TM 6-225

WAR DEPARTMENT TECHNICAL MANUAL

FIELD ARTILLERY TRAINER, M3

WAR DEPARTMENT • NOVEMBER 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 6-225

This manual supersedes TM 6-225, 15 January 1941, and Training Circular No. 29, War Department, 1943

FIELD ARTILLERY TRAINER, M3

WAR DEPARTMENT • *NOVEMBER 1944*

United States Government Printing Office

Washington : 1944

WAR DEPARTMENT,
WASHINGTON 25, D. C., 15 November 1944.

TM 6–225, Field Artillery Trainer, M3, is published for the information and guidance of all concerned.

[AG 300.7 (15 Jul 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

As prescribed in paragraph 9a, FM 21–6, except hosps; R 6 (5); Bn 6 (5); IBn 4 (1).

IBn 4: T/O & E 4–45, 4–65, 4–155.

For explanation of symbols, see FM 21–6.

CONTENTS

	Paragraph	Page
SECTION I. GENERAL		
Description	1	1
Operations	2	6
Adjustment of sighting equipment and calibration	3	8
Care and maintenance	4	9
Safety precautions	5	13
II. SERVICE OF THE PIECE		
General	6	14
Personnel of the firing battery	7	14
Duties of personnel at the gun position	8	14
Procedure	9	14
III. PREPARATION OF TERRAIN FOR FIRING		
General	10	16
Gun position	11	16
Observation posts	12	16
Target area	13	17
IV. CONDUCT OF FIRE		
General	14	18
Preparation of data	15	18
V. SUGGESTED TRAINING USES		
Training uses	16	19
APPENDIX I. FIRING TABLE		22
INDEX		27

This manual supersedes TM 6–225, 15 January 1941, and Training Circular No. 29, War Department, 1943

Section I

GENERAL

1. Description

a. GENERAL. The field artillery trainer M3 is a unit comprised of a miniature gun mounted on a miniature carriage which carries a panoramic telescope and the necessary mechanisms for moving the carriage in deflection and in elevation. A complete catalog of parts, tools, and accessories is given in SNL L–4. Two distinct mechanisms, each operated in conjunction with a gunner's quadrant, are provided within the carriage for laying the gun independently for angle of site and for range (or elevation), thus giving an independent line of sighting. Four trainers mounted on a firing platform comprise a field artillery trainer battery (figs. 1 and 2). The ammunition consists of compressed air as the propellent and a 1-inch commercial steel ball as the projectile. The range obtainable depends upon the pressure of the compressed air.

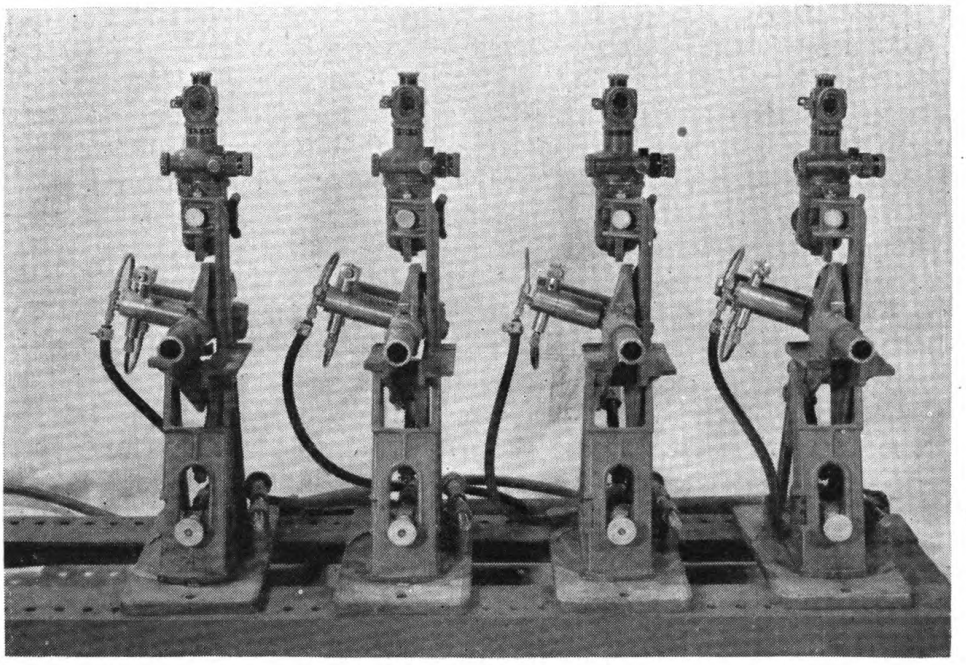


Figure 1. Front view of M3 trainer with M12 panoramic telescope.

Note.—For military terms not defined in this manual, see TM 20–205.

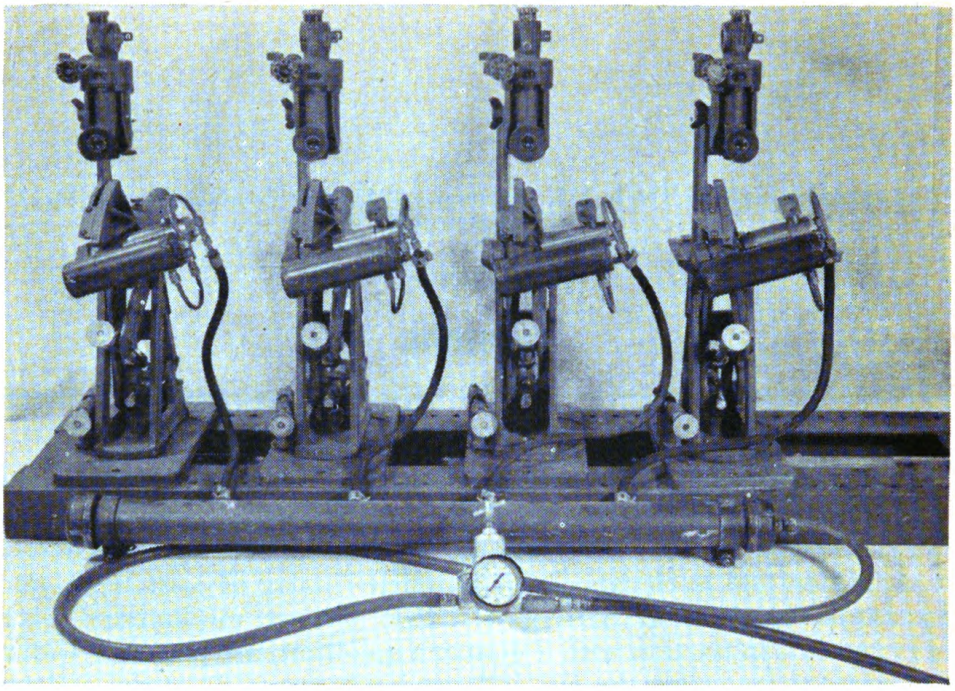


Figure 2. Rear view of M3 trainer with M5 panoramic telescope.

b. GUN (figs. 3 and 4). The gun consists essentially of a 1-inch inside diameter smooth bore barrel closed at the breech end by a compressed-air firing mechanism. The firing mechanism consists of a reservoir for compressed air, a quick-operating valve, and a spring-actuated trigger arrangement which operates the valve and insures a constant rate of opening each time the trainer is fired.

c. CARRIAGE (figs. 3 and 4). The carriage consists of a base plate, a top carriage designed to rotate about the base plate pintle through an angle of 800 mils, a cradle trunnioned in the top carriage and designed to elevate between 0 and 910 mils, and a rocker which carries a socket for mounting the panoramic telescope mounted on the same trunnion pin and designed to permit a movement in angle of site between minus and plus 125 mils. The base plate contains a hole at either end for use in assembling the base plate to the firing platform. A gunner's quadrant seat for elevation is formed on the right side of the cradle; a gunner's quadrant seat for angle-of-site settings is formed on the left of the rocker. The adjustable index (range) is assembled to the arc-shaped portion of the rocker. Slotted holes in the index permit adjustment when boresighting. The range scale assembled to the arc-shaped portion of the cradle is arbitrary and will not give true range at any constant pressure.

d. AMMUNITION, ACCESSORIES, AND SIGHTING EQUIPMENT (fig. 5). (1) *Ammunition.* The compressed air for firing the trainer is furnished by a compressor which is normally issued to field artillery with unit equipment, second echelon, set No. 3, or other standard air compressor equipment. Standard commercial 1-inch steel ball bearings are used as projectiles. Ammunition allowances are given in SNL L–4.

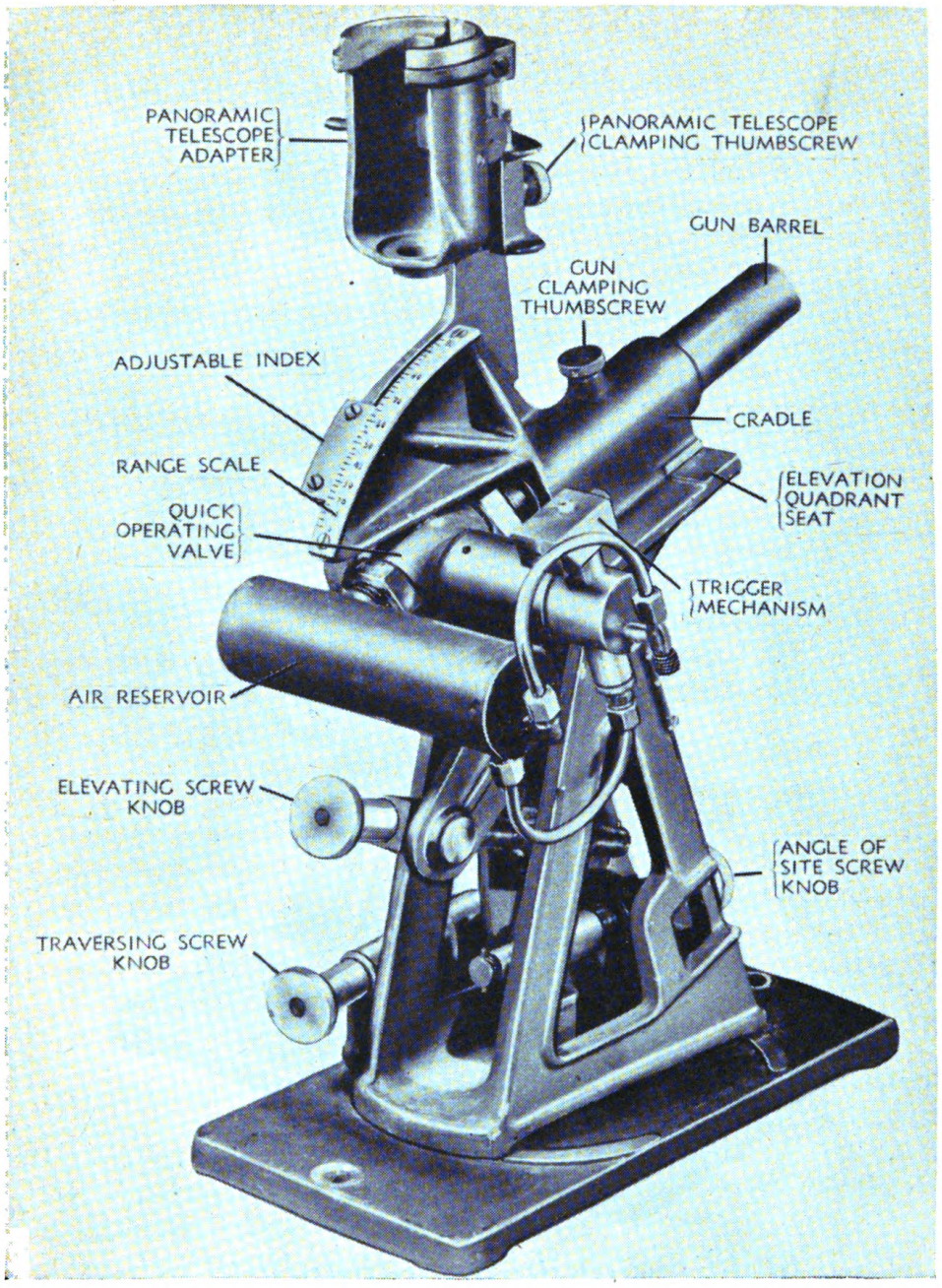


Figure 3. Rear-view close-up of field artillery trainer M3.

(2) *Artillery trainer tool chest.* The tool chest is a rectangular wood chest arranged for storage of the trainer battery accessories, steel balls, and miscellaneous materials such as cleaning and preserving materials. One chest is issued per trainer battery.

(3) *Chest, M9.* This chest is provided for each trainer battery to provide for the safekeeping of the four panoramic telescopes in those organizations which are not already equipped with panoramic telescopes.

(4) *Firing platform.* Two angle irons, held apart rigidly at the proper distance by steel strips welded to the ends of the angle irons, form

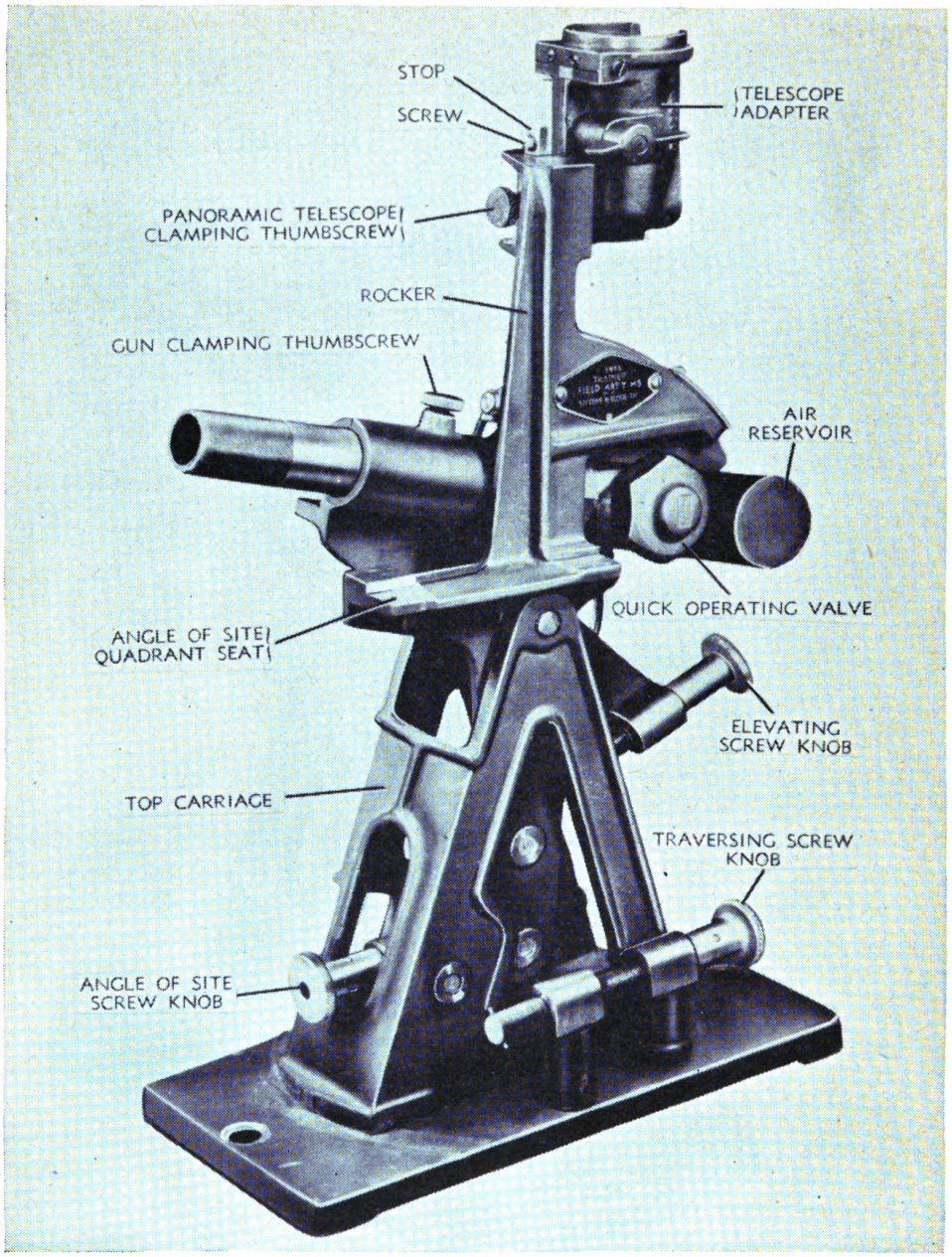


Figure 4. Front-view close-up of field artillery trainer M3.

a firing platform 60 inches long and 14.5 inches wide. Each side rail contains 38 holes, each spaced 1.44 inches, to permit varying the spacing of the trainers to simulate various intervals between the pieces in the battery. Eight cap screws and eight wing nuts are used to attach the trainers to the platform. One platform is furnished each trainer battery.

(5) *Artillery trainer cover.* A canvas trainer cover, complete with grommets and thongs for fastening, is provided for each trainer battery. The trainers must be spaced on the firing platform at 8.64-inch intervals or less, to utilize the cover for the entire trainer battery.

(6) *Spacer cleaning brush.* This brush consists of a 3/8-inch by 8-inch brass tubular handle, to which is sweated a steel wire brush similar to the type used for cleaning a shotgun. It is used to clean the bore.

(7) *Reamer.* The reamer is a standard 1-inch machine reamer modified by the addition of a 1/4-inch by 4-inch handle. One reamer is supplied to each trainer battery to remove burs from the inside of the barrel.

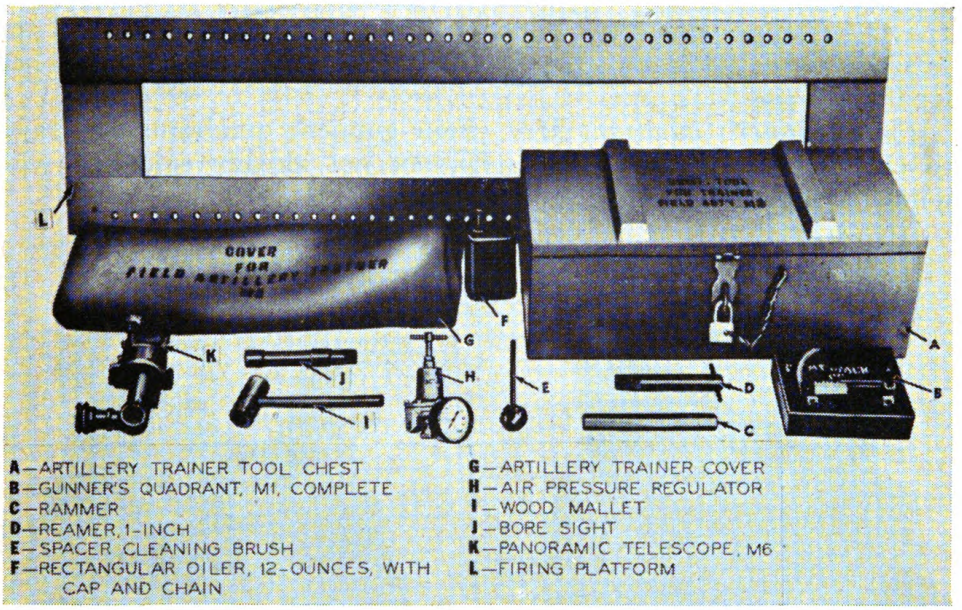


Figure 5. Accessories, sighting, and fire control equipment for field artillery trainer battery.

(8) *Rammer.* The steel rammer is used to assure proper seating of the projectile in barrel. One rammer is provided for each trainer battery.

(9) *Rectangular oiler with cap and chain.* A 12-ounce capacity oiler is used in lubricating the moving parts of the trainer. Two oilers are furnished each trainer battery.

(10) *Wood mallet.* A wood mallet is used to strike the plunger and fire the trainer. One mallet is furnished each trainer.

(11) *Air pressure regulator.* The air pressure regulator is used to maintain a constant air pressure. One valve is furnished each trainer battery.

(12) *Bore sight.* The bore sight is a cylindrical steel tube with two bearing surfaces formed on its outer diameter. The knurled end of the bore sight contains a peep sight, and the other end a clover-leaf reticle front sight. One bore sight is furnished each trainer battery.

(13) *Panoramic telescope.* Four panoramic telescopes are provided for each trainer battery issued to organizations not already equipped with panoramic telescopes. These telescopes will be one of the following types:

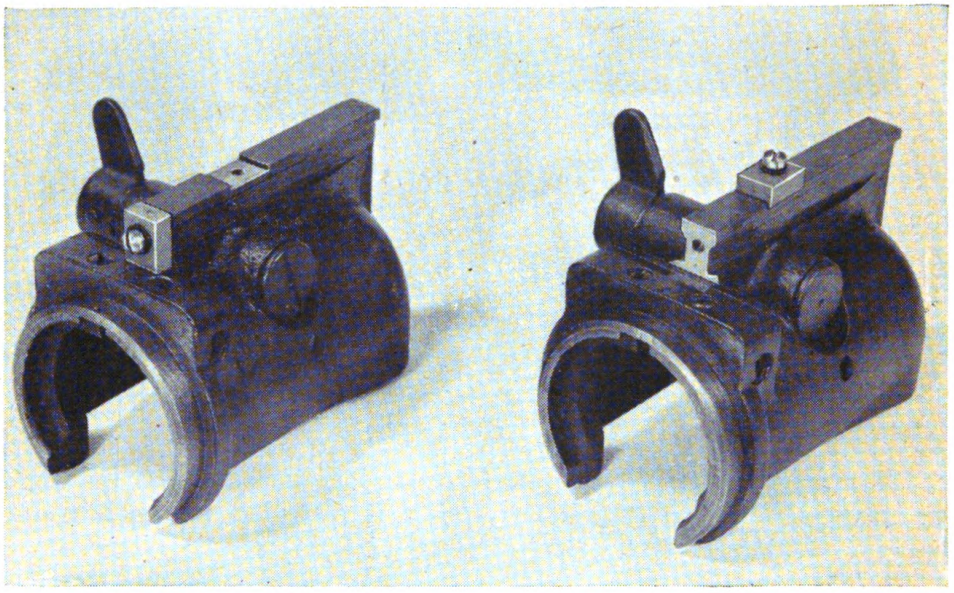
(*a*) Panoramic telescope M5.

(*b*) Panoramic telescope M6.
(*c*) Panoramic telescope M12.

(14) *Adapter.* (*a*) Appropriate adapters (fig. 6) for using the panoramic telescopes M5 and M12 are furnished by the Ordnance Department. The adapters have a stop on the front slide with two positions. The upper position is for use with the M12 telescope and the lower position for use with the M5 telescope. No adapter is used with the M6 telescope.

(*b*) The line of sighting of the M5 and M12 panoramic telescopes (fig. 7) is approximately 2.2 inches above the line of sighting of the M6 panoramic telescope when the adapter stop is properly positioned for the M5 and M12.

(15) *Gunner's quadrant M1.* Four gunner's quadrants are issued to each trainer battery of organizations not already equipped with gunner's quadrants.



Left: Stop positioned for panoramic telescope M12.

Right: Stop positioned for panoramic telescope M5.

Figure 6. Adapter, panoramic telescope.

2. Operations

a. To Mount Gun in Trainer Carriage. Screw the gun barrel nut (fig. 9) as far as it will go onto the adapter of the assembled firing mechanism. Then screw the gun barrel onto the adapter as far as it will go and back the nut until it contacts the barrel. Approximately ½ inch of threads should be exposed on the adapter. Slip the barrel into the cradle of the carriage through the rear so that the trigger mechanism is to the right. Secure the gun barrel with the gun clamping thumbscrew.

b. To Mount Trainers. The four trainers are placed on the firing platform and secured by means of the eight cap screws and wing nuts.

Minimum interval for operation is 8.64 inches center-to-center, using every seventh hole in the firing platform. An approximate 100-yard battery front may be simulated by mounting the trainers 11.52 inches center-to-center, or using every ninth hole on the platform.

c. To Load the Piece. The firing pressure desired is set on the air pressure regulator. A projectile is inserted in the muzzle and seated by means of the rammer. Failure to seat the projectile properly causes variation in muzzle velocity.

d. To Lay the Piece for Direction. The panoramic telescope having been inserted in its socket and the thumbscrew secured, the deflection ordered is set off on the panoramic telescope. The piece is

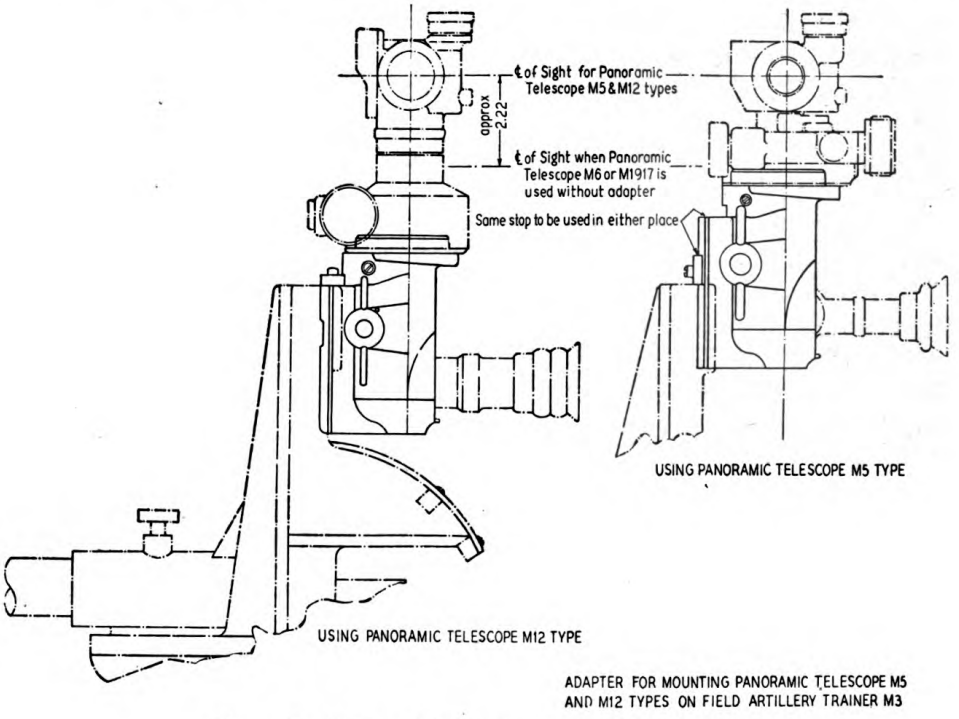


Figure 7. M12 and M5 telescopes with adapter.

then traversed by means of the traversing screw knob until the vertical hair of the telescope is on the aiming point. To minimize the effects of lost motion, the last motion in traversing for all pieces of the battery should be from left to right.

e. To Lay the Piece for Site. The site ordered is set on the gunner's quadrant; then the quadrant is placed on the angle-of-site quadrant seat and the bubble is centered by means of the angle-of-site screw knob. In order to minimize the effects of lost motion, the last motion in elevating should cause the breech to move upward.

f. To Lay the Piece for Range or Elevation. (1) *For range.* Using the elevating screw knob, the range ordered is set off by bringing the proper range graduation on the range scale opposite the adjustable index. The angle of site must also be applied when this method of laying for elevation is used. The last motion should cause the breech to move upward.

(2) *For quadrant elevation.* The quadrant elevation ordered is set off on the gunner's quadrant; then the quadrant is placed on the elevation quadrant seat and the bubble is centered by means of the elevating screw knob. The angle-of-site mechanism is disregarded when the piece is laid by this means. The last motion should cause the breech to move upward.

g. To Fire the Piece. To fire the piece, strike the trigger mechanism plunger with the wood mallet.

3. Adjustment of Sighting Equipment and Calibration

a. General. Battery personnel are forbidden to disassemble any part of the panoramic telescope and will make only such adjustments as are herein prescribed. Adjustments are to be made only by authorized personnel with the tools provided for that purpose by the Ordnance Department. If, under any circumstances, it is found that the following procedure fails to correct the errors in the sighting system, the matériel should be turned in to the Ordnance Department for repairs.

b. Testing Equipment. Equipment used in testing consists of a bore sight and a gunner's quadrant.

c. Procedure. The procedure for verifying and adjusting the sighting and laying system is as follows:

(1) Place the firing platform of the trainer battery on a level foundation. With the gunner's quadrant set at zero on the left-hand quadrant seat (angle-of-site), center the bubble with the angle-of-site screw knob. Without disturbing the setting, move the quadrant to the right-hand seat (elevation) and center the bubble with the elevating screw knob. The zero on the range scale should now coincide with the index. If it does not, loosen the two screws which secure the index to the carriage, slide the index up or down until it coincides with the zero, and tighten the screws.

(2) Remove the firing mechanism from the barrel and place the barrel in the cradle. Tighten the barrel by means of the gun clamping thumbscrew. Insert the bore sight in the barrel. If the object on which the gun is to be boresighted is located in front of the gun, the barrel should be inserted in reverse in the cradle to facilitate boresighting.

(3) Suspend a plumb bob or other similar weight with a cord at a distance of about 50 feet either in front or in rear of the trainer battery. Then traverse the gun to bring the line of boresighting to the cord. With the panoramic telescope mounted, turn the rotating head to bring the cross hairs to the cord. To correct any error from zero deflection with the panoramic telescope M6, loosen the screw holding the movable azimuth micrometer scale index and move the index to read zero deflection. For sights using the panoramic telescope adapter, corrections in adjustment may be made by using the tangent screws in the adapter.

(4) The vertical interval between the tube and the cross hairs of the panoramic telescope may be indicated on the vertical cord by knotting another short piece of cord around the vertical cord at the

specified distances. For the panoramic telescopes M5 and M12 the interval is 11.75 inches, and for the panoramic telescope M6 the interval is 9.5 inches. Figure 7 shows that the line of sight of the objectives of the M5 and M12 type panoramic telescopes are in coincidence when the "stop" is positioned correctly. Correct position of the stop is further shown in figure 6. Distant aiming points, where such are available, should be used for outdoor operation. The guns in the trainer battery may be laid parallel by use of the aiming circle.

d. CALIBRATION. (1) Calibration firing should be done on level ground. Adjust the barrels of the trainers so that ½ inch of threads on the gun barrel adapters are exposed. Adjust the air pressure at the guns with the air pressure regulator to 40 pounds per square inch. Fire the pieces at a midrange for that pressure. Select the piece that shoots the greatest range as the base piece. Adjust the other trainers to shoot that range with the same quadrant elevation setting by screwing the barrels out on the adapters. Screwing the barrel out on the adapter ½ inch will increase the range by approximately ⅔ yard using 40 pounds per square inch pressure at midrange. For determining the centers of impact, fire groups of 6 to 10 rounds, measuring the range of each round, and compute the center. Adjust the other pieces until they have centers of impact within a yard of that of the base piece.

(2) The firing tables furnished in this manual are based upon pressures as indicated by the issued pressure regulator gauge with ½ inch of thread on the gun barrel adapter exposed. As the calibration of pressure gauges may vary, slight variances from the firing tables may be expected.

4. Care and Maintenance

a. GENERAL. (1) Examine the trainer battery for general condition, appearance, and loose or damaged components.

(2) Test the trainer for elevation and traverse through its full range and note any binding, lost motion, or sluggish movement.

(3) Test the functioning of the gun and check carefully for any air leaks at any connections.

(4) Tighten all loose connections carefully to avoid damage to the connections.

(5) Oil the elevating and traversing screws and sliding surfaces; maneuver the components to distribute the oil evenly and to eliminate sluggish movement or binding.

(6) All foreign matter must be removed from the projectiles before firing. The projectiles should be oiled lightly between periods of firing to prevent rust.

b. GUN BARREL. (1) During extended periods of firing the gun barrel should be inspected for cleanliness. Any foreign matter should be removed with the spacer cleaning brush dampened (but not wet) with dry-cleaning solvent.

(2) Examine the bore for burs or a rough ring (which may be formed after a large number of balls have been fired). This will cause

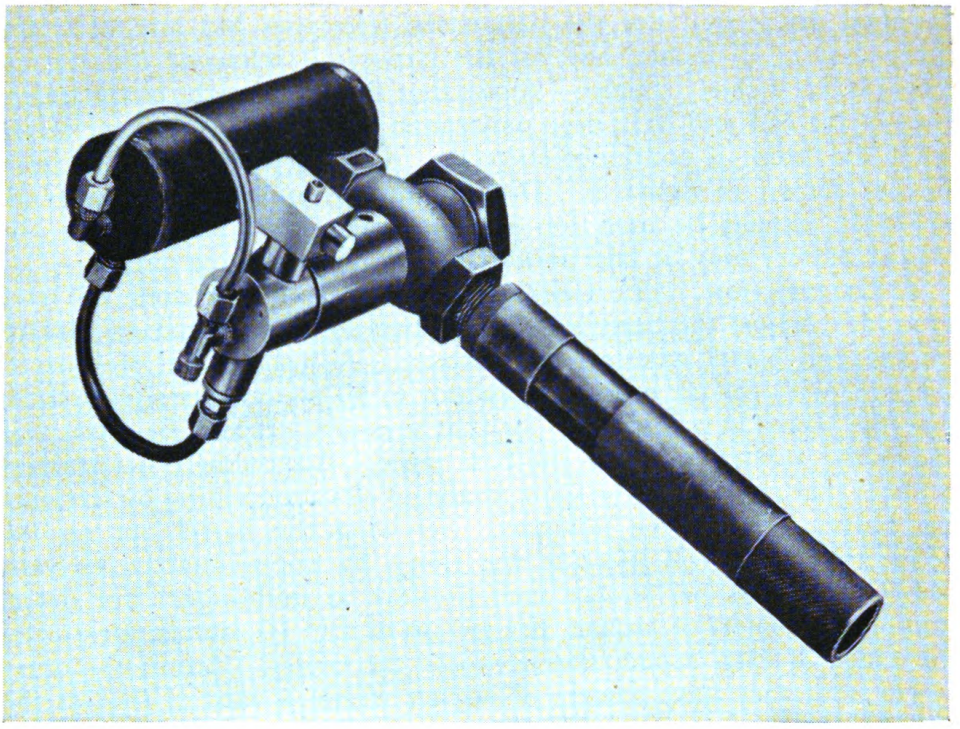


Figure 8. Firing mechanism removed from carriage.

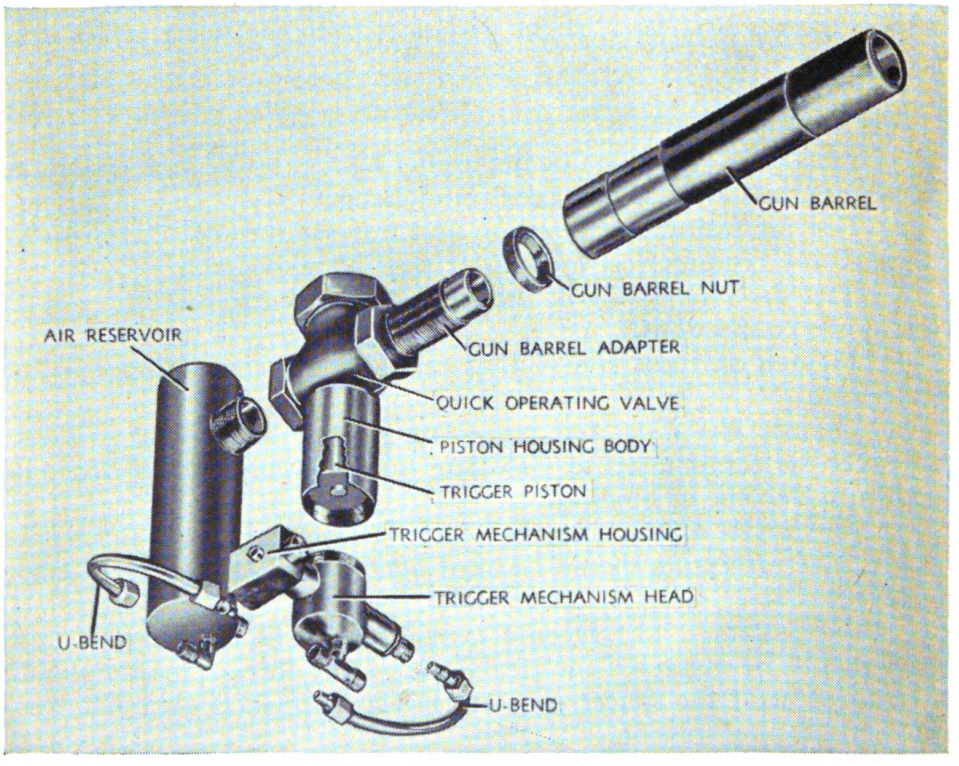


Figure 9. Chief components of firing mechanism.

errors in deflection and range. To remedy this condition, smooth out the bore with the reamer.

(3) The gun barrel is removed from the firing mechanism at the completion of firing (figs. 8 and 9) and is cleaned with a cleaning brush dampened with dry-cleaning solvent, dried thoroughly with a clean dry wiping cloth, and lightly oiled with a clean cloth and special preservative lubricating oil.

c. Firing Mechanism. Examine at completion of firing for dirt or water. If the firing mechanism is excessively dirty or if it has been exposed to rain, disassemble and clean as prescribed in the detailed disassembly in *d* below. Detailed disassembly is required for weekly maintenance, immediately after firing, or if the trainer is to be stored for a period longer than one week.

d. Detailed Disassembly of Firing Mechanism (weekly maintenance). (1) (*a*) Disconnect the rubber hose from the trainer.

(*b*) Remove the gun barrel and clean as instructed in *b* above.

(2) Disconnect the two **U**-bends from the air reservoir and firing mechanism (fig. 9).

(3) Examine the barrel adapter and nut for burred or damaged threads. If the threads are damaged, turn the valve over to ordnance maintenance personnel.

(4) Remove the trigger mechanism head cap from the head (fig. 11). Press in the trigger mechanism plunger and remove the trigger mechanism piston and piston spring. Remove trigger mechanism plunger and plunger spring.

(5) Rotate the trigger mechanism housing counterclockwise 90 degrees.

(6) Using a wrench on the trigger mechanism housing, loosen the trigger mechanism head from the piston housing body (fig. 9). The piston housing body should be held by a spanner wrench to prevent rotation while the trigger mechanism head is being loosened.

(7) Remove the trigger mechanism housing.

(8) Remove the trigger mechanism head.

(9) Remove the trigger piston from the piston housing body.

(10) Examine all parts for burs or damage. If any parts are damaged, turn the quick operating valve over to ordnance maintenance personnel for repair.

(11) Further disassembly is restricted to ordnance maintenance personnel.

(12) Clean all parts with dry-cleaning solvent and lubricate with special preservative lubricating oil.

e. Reassembly of Firing Mechanism. (1) Replace the trigger piston in the piston housing body with the hollow side leading.

(2) Replace the trigger mechanism head on the piston housing body.

(3) Screw the trigger mechanism housing on the trigger mechanism head to one-quarter turn of the tight position. Using a crescent wrench on the housing and a spanner wrench on the piston housing body, tighten the trigger mechanism head. Tighten the trigger mechanism housing.

(4) Replace the plunger spring in its seat in the trigger mechanism plunger and insert the unit in the horizontal recess in the trigger mechanism housing. Slip the piston spring onto the trigger mechanism piston plunger and insert the unit in the horizontal recess in the trigger mechahead. Manipulate the trigger mechanism plunger while the piston is being inserted so that it will engage the piston around its narrow neck (a click will be heard). Replace the trigger mechanism head cap on the trigger mechanism head.

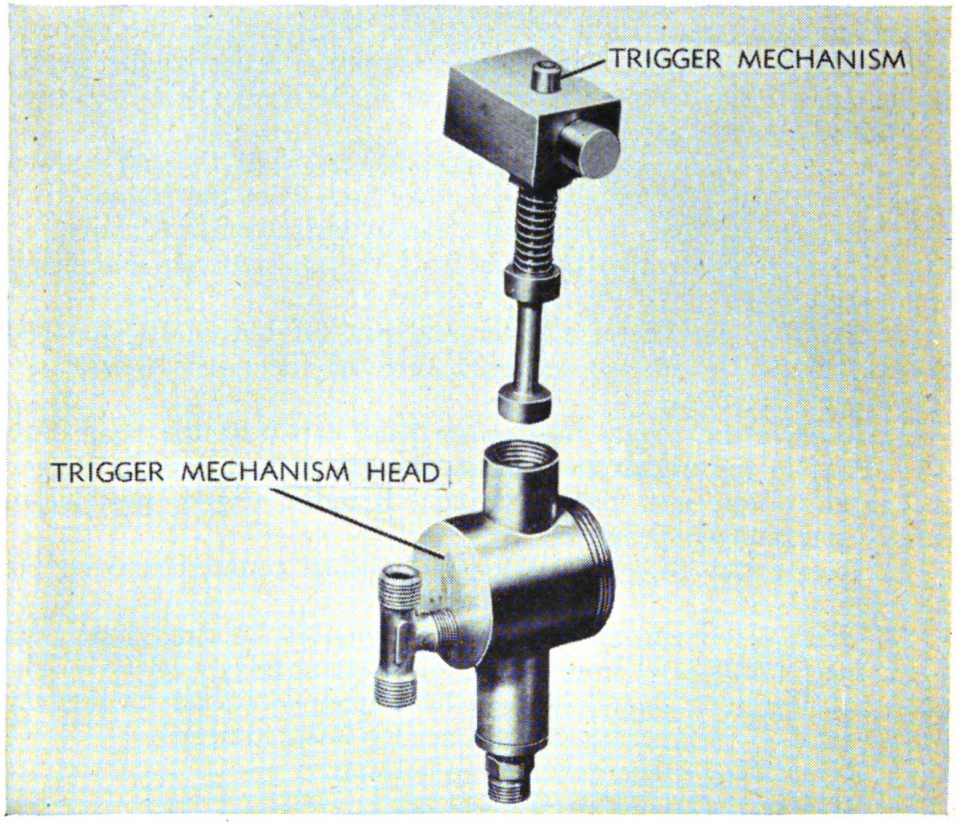


Figure 10. Chief components of trigger mechanism.

(5) Connect the **U**-bends to the air reservoir and the trigger mechanism.

(6) Screw the barrel nut onto the barrel adapter and follow with the barrel. Back off the nut until it contacts the barrel.

(7) Mount the firing mechanism with barrel assembled in the trainer carriage and secure with the gun clamping thumbscrew.

(8) Connect the rubber hose to the firing mechanism.

f. If the quick operating valve leaks when in the closed position, turn the valve over to ordnance maintenance personnel for repair. A slight leakage around the trigger mechanism is normal. Do not confuse this leakage with leakage of the quick operating valve.

g. CARRIAGE. (1) Clean the carriage with dry-cleaning solvent, dry thoroughly with a clean wiping cloth, and oil with special preserva-

tive lubricating oil. It is essential that all moving parts are oiled. Keep the quadrant seats clean and coated with a light film of oil.

(2) When the trainer battery is not to be used for a long period of time, all parts should be cleaned with dry-cleaning solvent, dried thoroughly, and coated with light rust preventive compound.

h. To prevent moisture in the compressed air from entering the firing mechanism, a condensate trap should be placed in the air line between the air compressor and the pressure regulating valve, near the pressure regulating valve. This trap should be drained daily while the trainer battery is in operation.

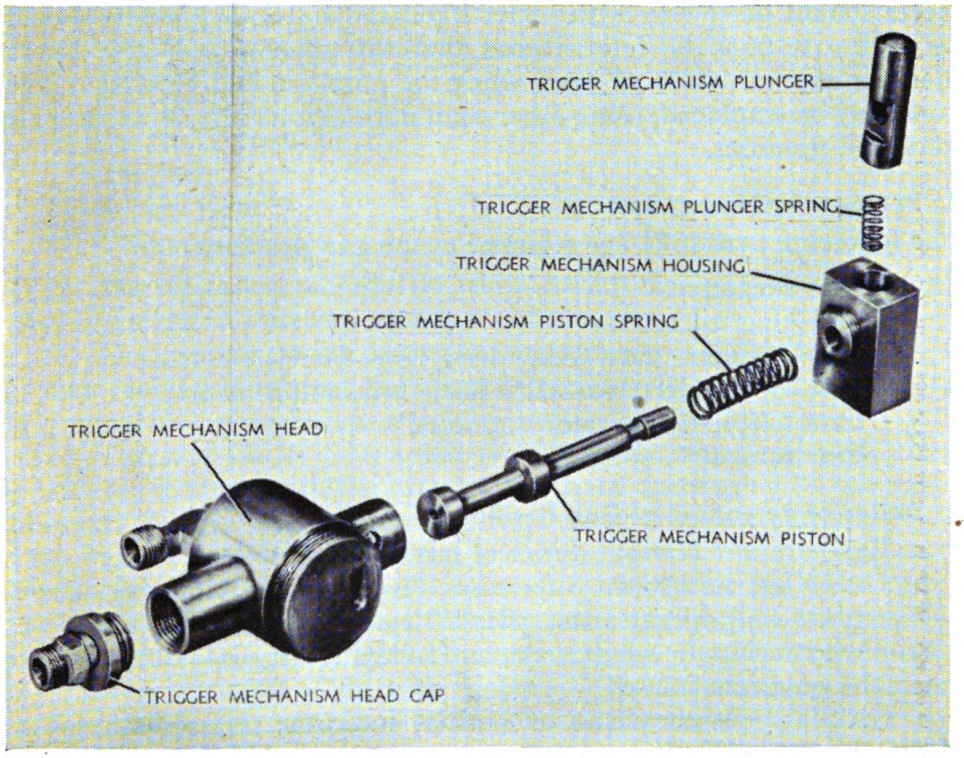


Figure 11. Trigger mechanism, parts.

5. Safety Precautions

As a projectile, the 1-inch ball bearing is dangerous while in flight. Hence, no unprotected personnel should be allowed in front of the muzzle in the line of fire and within the range for which the trainers are laid. The executive should watch the line of fire and direct exposed personnel to points of safety. The shot loader should load the pieces in such a sequence that will not place him in front of a loaded piece at any time. If an observation post lies close to the line of fire, its occupants must be protected by a sloping roof of light wood or other suitable material.

Section II

SERVICE OF THE PIECE

6. General

The four guns emplaced in line with 11.52-inch intervals correspond to a battery with 33-yard intervals. With such restricted intervals it is difficult to serve the pieces using four gunners; hence two gunners will normally be used to lay the four pieces when the intervals are 11.52 inches. When maximum rapidity in firing is desired, the pieces should be spaced with wider intervals, and four gunners should be used. It must be remembered that this spacing will give larger than the normal width of sheaf when the guns are laid parallel. The guns may be emplaced, using other than normal intervals, as to simulate staggered positions.

7. Personnel of Firing Battery

The following personnel are required at the gun position:

One executive.
One chief of section.
Two gunners (four when using large intervals).
One shot loader (two when firing bracket problems).
One telephone operator (optional).
One recorder (optional).

8. Duties of Personnel at Gun Position

a. EXECUTIVE. Normal duties of battery executive.

b. CHIEF OF SECTION. Supervises the loading and laying of the pieces. Sets and operates the gunner's quadrant in laying the pieces for site when using the range scale, and in laying the pieces for elevation when the quadrant is used.

c. GUNNER. With pieces at normal intervals, serves both pieces of the platoon. His duties involve centering the bubble of the gunner's quadrant, laying for range when the range scale is used, laying for direction, and firing the piece.

d. SHOT LOADER. Loads ball bearings in pieces designated to fire, pressing the ball bearing home in each instance.

e. TELEPHONE OPERATOR (when present). Operates the telephone at the gun position.

f. RECORDER. Acts as recorder at the gun position.

9. Procedure

a. PREPARATORY STEPS. The guns are emplaced on the firing base by the artillery mechanic as directed by the battery commander. The firing base, with the guns mounted thereon, is transported to the battery position and put in firing position.

b. PREPARATION FOR ACTION. The gunners procure the panoramic sights and put the sights in their sockets. The chief of section procures the gunner's quadrant, measures the exposed thread on the gun barrel

adapters to insure that the pieces are properly calibrated. The shot loader places the 1-inch ball bearings where they will be conveniently available. The telephone operator and recorder, when present, take their positions as at service practice. The executive checks on the above, and when satisfactorily completed, reports the battery in order to the battery commander.

c. Execution of Commands. (1) When fire commands are received from the officer conducting fire, the procedure is as shown by the following example:

Battery adjust
Shell HE
Charge 3
Fuze quick
Base deflection right 150
On No. 2 open 5
Site 305
Battery right
Elevation 300

(2) The recorder records the data received. The executive announces the data to the gun squads.

(3) The gunners set the deflections and deflection differences ordered for their pieces and traverse the pieces by the traversing screw knobs until the vertical hair of each sight is on the aiming point.

(4) The shot loader puts a ball bearing in the muzzle of each piece and presses it home with the rammer, verifying the seating by the scale. ***Caution:*** When loading the guns, the shot loader should stand in front of the battery and move backwards across the battery front loading each piece in turn so that he will never pass in front of a loaded piece.

(5) The chief of section sets 305 mils on the quadrant and, beginning with the piece designated to fire first, places the quadrant on the seat provided on the right of the tube, holding it there until the gunner has centered the bubble by means of the elevating screw knob. The other pieces are then laid in sequence, in a similar manner.

(6) The gunners check the laying for elevation and direction. They then call, "No. 1 (etc.) ready."

(7) The executive gives the signal and order to fire to the gunners.

(8) The gunners fire their pieces on order of the executive.

(9) The telephone operator gives the information on firing to the observation post as, "On the way," and "(So many) rounds completed."

(10) The shot loader loads or reloads on the announcement of the elevation or range.

d. Retrieving Shots Fired. One or more men should be stationed to the right and left of the line of fire and opposite the target to locate the ball bearings after they are fired. During lulls in firing these men collect the ball bearings and return them to the shot loader.

e. Cleaning Pieces. Upon the completion of the practice the pieces are cleaned under direction of the executive, and the equipment, cleaned and oiled, is replaced in the chest, the guns remaining on the firing base.

Section III

PREPARATION OF TERRAIN FOR FIRING

10. General

Any fairly level field with dry sand or loose loam surface soil and little vegetation is suited for the use of the field artillery trainer. The field should be about 50 yards wide and 90 yards long. Due to the reduced scale on which the miniature battery is designed to operate, the terrain requires certain preparation prior to firing. If the firing base is placed on the ground, the guns will have an altitude corresponding to 100 feet or more, as the gun trunnions are a foot or more above the bottom of the firing base. A man, the height of whose eyes when standing is 5 feet, will, if observing fire standing, be observing from an altitude corresponding to 500 feet. This distortion should be corrected by digging pits, so that the guns and the observers will be at approximately normal altitudes with reference to the terrain.

11. Gun Position

Although all references throughout this manual have been made to the gun positioned on the firing base, it can be fired from other positions. At pressures up to 50 pounds it can be fired from a flat table top with very little displacement. At higher pressures it can be bolted to the wooden firing base (fig. 12). The advantage of the table top and the wooden firing base is that the guns can be staggered to closer simulate actual gun positions. (***Caution:*** When staggering the guns, care must be taken that no strain is placed on the rubber hose and copper tubing connections that carry the compressed air.) Regardless of what base is used for the weapons, a trench should be prepared so that the gun muzzles will be about 1 inch above the ground when the pieces are laid with the barrels level, zero angle of elevation and zero angle of site. A trench must be dug in rear of the guns so that the gunners will be able to look through the eyepieces of the panoramic telescopes and be able to serve the pieces in comfort. To avoid repetition of data, the locations of aiming points, observation posts, and targets should be changed from day to day.

12. Observation Posts

Observation posts should be constructed at points to give the observer all types of terrestrial observation. Trenches for observers must be such that the observer's eyes are from 10 to 15 inches above ground, cor-

responding to an elevation of about 80 to 125 feet. If an observation post lies close to, or in the line of fire, its occupants must be protected by a sloping roof of light wood or other suitable material.

13. Target Area

An area 50 yards wide and 70 yards long located 20 yards in front of the battery position makes an excellent target area. The ground should be soft, of loose sand or light loam, so that the shot in striking the ground will raise a puff of sand or dust visible to the observer through field glasses. The ground directly in front of the battery position should be clear of all grass or weeds to avoid erratic firing. To stimulate interest, the target area may be made to represent actual terrain in miniature: hills, valleys, trees, houses, enemy battery positions, etc. Care must be taken not to make objects relatively too large; all should be reduced to one one-hundredth of their normal size. Four blocks of wood, ¾ inch wide and ⅜ inch tall, spaced 11.52 inches apart would represent four guns of a hostile battery at normal intervals. A two-story house, 30 feet wide and 40 feet in depth, would be represented by a block 2½ inches high, 3½ inches wide, and 4¾ inches long. Hills 150 feet high and 1,000 yards apart would be represented by hills 10 yards apart and 1½ feet higher than the intervening valley. For indoor use of the trainer, a target area may be constructed by placing sawdust on the floor, confining it to the area by the use of sidewalls. Recovery of the projectiles is facilitated by the use of a canvas backstop.

Section IV

CONDUCT OF FIRE

14. General

Conduct of fire is the same as with service ammunition with the obvious exception of any fire calling for air bursts.

15. Preparation of Data

a. In order that computations of data may correspond to those of a standard battery and so that deflection differences may be more comparable to the usual deflection differences of an actual battery in a normal situation, aiming points should be used whose distances are about one one-hundredth of the aiming point distance in a normal situation. Aiming point ranges usually are from 2,000 to 10,000 yards. To get corresponding offsets and parallaxes, the aiming points selected for a miniature battery should have ranges of from 20 to 100 yards.

b. On the reduced size terrain, data may be estimated or computed.

c. The gun position, observation post, line from gun position to aiming point, and location of targets can be plotted accurately on a grid sheet, using a steel tape and aiming circle to obtain distances and azimuths. To utilize 1/20,000 plotting equipment a chart scale of 1/200 is convenient. A map of the area may be prepared on a scale of 1/200 and used to prepare data.

d. To secure correct results from map or plotted data, the observer's eyes must be approximately at the position plotted for the observation post. An error of 1 yard corresponds to 100 yards. After a problem is started, the officer conducting fire should not change his position, as any movement is multiplied 100 times on the reduced terrain.

Section V

SUGGESTED TRAINING USES

16. Training Uses

a. The trainer battery can be used in many kinds of training in addition to the normal conduct of fire training as described in section IV.

b. (1) Members of gun squads can be trained in laying for deflection and elevation.

(2) Battery recorders and telephone operators may be trained at the same time that conduct of fire practice is being carried on.

(3) Practice in direct laying can be given gun crews with the trainer. For tracking moving targets, the gun should be mounted on a wooden firing base (fig. 12) so that the gun can be traversed smoothly. In using the panoramic telescope with the gridded reticle, the gunner applies the announced lead and range on the grid by traversing the wooden firing base for direction and by using the angle-of-site screw knob for range. With a panoramic telescope which does not have the gridded reticle, the gunner applies the lead on the mil scale of the reticle and traverses the gun. The shot loader applies the range by using the elevating screw knob. The shot loader fires the piece on the command of the gunner in both of the above systems of laying. The following method is suggested for direct laying:

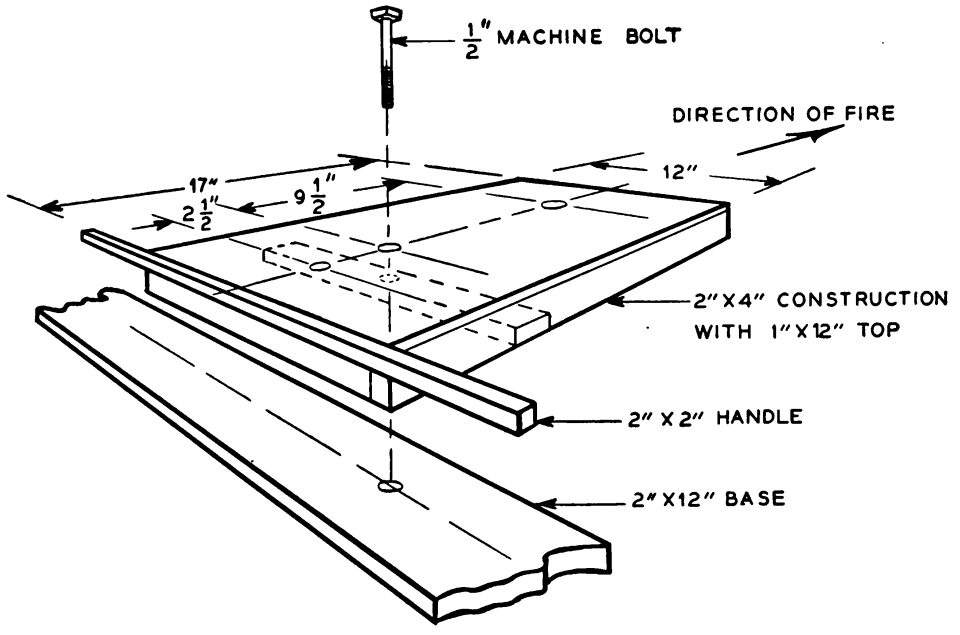


Figure 12. Wooden firing base for field artillery trainer M3 when used in direct laying.

(*a*) Set the air pressure regulator at 80 pounds per square inch.

(*b*) Adjust the piece to fire at a range of 25 yards.

(*c*) Without disturbing the laying of the tube, refer to the point of impact with a lead of zero and a range of 500 yards on the gridded reticle, thereby bore-sighting the piece on point of impact. The elevation knob of the panoramic telescope should then be held at that setting by a piece of adhesive tape.

(*d*) Use the angle-of-site screw knob for subsequent range commands. A range setting of 1,000 yards on the gridded reticle will give a hit at approximately 30 yards; a setting of 0 yards will give a hit at approximately 20 yards. Thus, a 1,000-yard field of fire on the panoramic telescope will give a 10-yard field of fire on the ground between 20 and 30 yards. For panoramic telescopes not having the gridded reticles, the gunner will keep the reticle on the target using the elevation knob on the telescope. Appropriate elevations are applied on the piece by the shot loader. Moving targets should be towed so as to give the same rate of traverse on the trainer as may be expected for actual targets with artillery weapons. One mile per hour target speed at a 25-yard range will approximate 20 miles per hour speed at a 500-yard range.

(4) Gun squads may be shown the effect of piece displacement and the effect of an aiming post displacement correction.

(5) Errors in boresight adjustment and the effect of corrections in adjustment can effectively be demonstrated.

(6) The battery executive may obtain practical experience in laying the battery, execution of fire commands, and in determining and reporting adjusted data.

(7) Effects of uncalibrated guns in the same unit can be shown and methods of calibration taught. For demonstrating this the guns must be put out of calibration by varying the exposed threads on the gun barrel adapters.

(8) The trainer may be used by fire-direction center personnel for practice in transfer and massing of fire. The effect of dispersed battery positions within the battalion can be shown by using one trainer to represent each battery. In doing this the trainers must be mounted individually and long air hoses used between the air reservoir and the firing mechanisms. As the trainer uses a 1/100 scale, the battery positions must be accurately located. The panoramic telescope is taken as the location of the battery. As an aid in laying out the firing range terrain and in plotting points on the terrain, grid lines 1 yard apart are represented on the terrain by wire or cord. Each 1-yard grid square on the trainer terrain will represent a 100-yard grid square. After the terrain is set up the wire or cord is removed so as not to interfere with the firing. Since the guns are usually located in a pit, their position is more or less fixed. The grid for the terrain should therefore be oriented with respect to the gun position. Altitude may be simulated by raising points on the terrain by means of a stake or a pile of sand to the desired scale.

(9) The battalion survey team may check the accuracy of a survey by use of the trainer to fire in their data. The terrain for the trainer

must accurately represent the ground on which the survey has been made. Actual coordinates, rather than those determined by the survey team, must be used in plotting base points, check points, and reference points on the terrain. Actual coordinates may be determined from a master survey or from a battle map of the area. Targets and gun positions may be plotted from coordinates determined by the survey team. Altitudes must be represented accurately.

(10) The battery short-base team may be trained in computing data for targets placed at random in the impact area. Their accuracy may be checked by firing on the targets that they locate. The length of the short base must be such as to give a normal angle of intersection and must be determined very accurately because of the reduced scale.

(11) Effects of staggered gun positions in the battery may be shown by the impact pattern in the target area. Dispersal in width may be obtained by shifting one or more guns on the firing platform. Dispersal in depth may be obtained by removing one or more guns from the firing base and placing them in front or in rear of the other pieces. This will give the battery executive practical experience in compensating for staggered gun positions when forming a regular sheaf.

(12) The trainer may be used to demonstrate the effects of dead space and the use of high-angle fire to reach targets which cannot be fired on with normal fire. By using both angle-of-site and elevation screws and by tilting the base of the trainer, suitable elevation may be set for high-angle fire.

(13) Air observation methods of adjusting fire may be simulated by placing the observer on a raised platform which can be constructed on a scale of 1/100 to represent the desired altitude.

Appendix I

FIRING TABLE

Firing table for field artillery trainer, M3, firing 1-inch steel ball (approximate weight 1024 grams).

Range (yards)	Charge 1 (40 lb./sq. in. pressure)		Charge 2 (50 lb./sq. in. pressure)		Charge 3 (60 lb./sq. in. pressure)	
	Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range
20	233	14	177	11	146	7
21	247	14	188	11	153	7
22	261	14	199	11	160	7
23	275	14	210	11	168	8
24	290	15	221	11	177	8
25	305	15	232	11	185	8
26	320	15	243	11	194	9
27	336	16	254	11	203	9
28	352	16	265	11	212	9
29	368	16	276	11	221	9
30	386	16	288	12	230	9
31	402	16	300	12	239	9
32	419	17	312	12	248	9
33	436	17	324	12	257	9
34	454	18	336	12	266	9
35	473	19	349	13	275	9
36	497	24	362	13	285	10
37	527	30	375	13	295	10
38	560	33	388	13	305	10
39	599	39	401	13	315	10
40	648	49	415	14	325	10
41	709	60	429	14	335	10
42	783	74	444	15	345	10
43			460	16	356	11
44			477	17	367	11
45	.....	.....	495	18	378	11
46	.....	.....	514	19	389	11
47	.....	.....	535	21	400	11
48	.....	.....	558	23	412	12
49	.....	.....	583	25	424	12
50	.....	.....	612	29	436	12
51	.....	.....	647	35	448	12
52	.....	.....	695	48	460	12
53	.....	.....	800	105	473	13
54	.....	.....	.....	.....	486	13
55	.....	.....	.....	.....	500	14
56	.....	.....	.....	.....	514	14

FIRING TABLE—Continued

Charge 4 (70 lb./sq. in. pressure)		Charge 5 (80 lb./sq. in. pressure)		Range (yards)
Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range	
120	7	.....	.....	20
127	7	.....	.....	21
134	7	.....	.....	22
141	7	.....	.....	23
148	7	.....	.....	24
155	7	.....	.....	25
162	7	.....	.....	26
169	7	.....	.....	27
176	7	.....	.....	28
183	7	.....	.....	29
190	7	.....	.....	30
197	7	.....	.....	31
204	7	.....	.....	32
212	8	.....	.....	33
220	8	.....	.....	34
228	8	.....	.....	35
236	8	.....	.....	36
244	8	.....	.....	37
252	8	.....	.....	38
260	8	.....	.....	39
268	8	227	6	40
276	8	233	6	41
284	8	239	6	42
292	8	245	6	43
300	8	252	7	44
308	8	259	7	45
316	8	266	7	46
325	9	273	7	47
334	9	280	7	48
343	9	287	7	49
352	9	294	7	50
362	10	301	7	51
372	10	308	7	52
382	10	316	8	53
392	10	324	8	54
402	10	332	8	55
412	10	340	8	56

FIRING TABLE—Continued

Range (yards)	Charge 1 (40 lb./sq. in. pressure)		Charge 2 (50 lb./sq. in. pressure)		Charge 3 (60 lb./sq. in. pressure)	
	Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range
57	.....	.....	.....	.....	529	15
58	.....	.....	.....	.....	545	16
59	.....	.....	.....	.....	562	17
60	.....	.....	.....	.....	581	19
61	.....	.....	.....	.....	603	22
62	.....	.....	.....	.....	635	32
63	.....	.....	.....	.....	685	50
64	.....	.....	.....	.....	800	130
65	.....	.....	.....	.....	.....	.....
66	.....	.....	.....	.....	.....	.....
67	.....	.....	.....	.....	.....	.....
68	.....	.....	.....	.....	.....	.....
69	.....	.....	.....	.....	.....	.....

FIRING TABLE—Continued

Charge 4 (70 lb./sq. in. pressure)		Charge 5 (80 lb./sq. in. pressure)		Range (yards)
Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range	
422	10	348	8	57
433	11	356	8	58
444	11	364	8	59
455	11	373	9	60
467	12	382	9	61
479	12	391	9	62
492	13	400	9	63
507	15	409	9	64
524	17	419	10	65
543	19	429	10	66
564	21	439	10	67
587	23	450	11	68
612	25	461	11	69

FIRING TABLE—Continued

Range (yards)	Charge 4 (70 lb./sq. in. pressure)		Charge 5 (80 lb./sq. in. pressure)		Range (yards)
	Elevation (mils)	Change in elevation for 1-yard change in range	Elevation (mils)	Change in elevation for 1-yard change in range	
70	638	26	472	11	70
71	665	27	484	12	71
72	693	28	496	12	72
73	723	30	509	13	73
74	756	33	522	13	74
75	800	44	535	13	75
76	.....	.....	548	13	76
77	.....	.....	561	13	77
78	.....	.....	575	14	78
79	.....	.....	590	15	79
80	.....	.....	606	16	80
81	.....	.....	634	18	81
82	.....	.....	654	20	82
83	.....	.....	682	28	83
84	.....	.....	720	38	84
85	.....	.....	800	80	85

INDEX

	Paragraph	Page
Adjustment of sighting equipment	3	8
Calibration	3	9
Conduct of fire, general	14	18
Description, general	1	1
Duties of personnel	8	14
Firing, service of piece, general	6	14
Firing table	App. I	22
Gun position, preparation	11	16
Maintenance	4	9
Observation posts, preparation	12	16
Operation of piece, general	2	6
Personnel	7	14
Duties at gun position	8	14
Precautions, safety	5	13
Preparation of—		
Firing data	15	18
Gun position	11	16
Observation posts	12	16
Target area	13	17
Terrain, general	10	16
Procedure, service of the piece	9	14
Safety precautions	5	13
Sighting equipment, adjustment	3	8
Terrain, preparation	10	16
Training uses	16	19